# UNIT 6:
# RADIATION EMERGENCIES

# LEARNING OBJECTIVES

By the end of this section, participants will be able to:

- Describe the basic types and functions of radiation survey instruments
- Identify the ways patients can become exposed/contaminated by radiation
- Explain how to control a situation involving a radiation release
- Identify the agencies that require reports when there is a radiation release

# INITIAL RESPONSE

In most cases, accident scenes involving radioactive materials are handled in the same way as any other hazardous materials incident. However, you may need to take different precautions, depending on the type and form of radiation, as well as the other hazards involved. The following information covers some of these issues.

When you arrive at a transportation incident scene, conduct a survey as you would with any other hazardous materials incident. If you see any indication that radioactive materials are involved (placards, labels, information from workers), look for the shipping papers, which will identify the radionuclides being transported. If radioactive contamination prevents you from searching, contact the carrier's dispatcher directly. Since you cannot see or feel radiation, never assume it is not present in these situations.

If you have radiation monitoring instruments and are trained in their use, survey the immediate area to find out if radiation is present. Monitor any accident victims if they do not have life-threatening injuries. Also, monitor the time in the hot zone. Remember that time, distance and shielding are your most effective protections against radiation hazards.

An initial radiation survey will only give you a preliminary estimate of radiological hazards. If you do not have access to the types of instruments that are used to take complete and detailed radiological readings, you should contact the appropriate authorities immediately.

# DETECTING RADIATION HAZARDS

Because radiation cannot be detected by the human senses, you must rely on instruments to confirm its presence. Two categories of instruments are currently used to detect the presence of radiation. Survey meters detect the presence of radiation. Dosimeters measure an individual's exposure or dose. Both types of instruments require specific training in their use and the interpretation of results.

## Survey Meters

Survey meters were originally designed to detect radiation in the event of a nuclear attack. Various types are available to detect alpha, beta, gamma, X-ray, and even neutron radiation, but the most commonly used types detect beta and gamma radiation. The others are more specialized and require more training in their use. A description of some of the more commonly used instruments is included in this section.

Two civil defense survey instruments are the **CD V-700** and the **CD V-715**. These instruments measure rate of exposure in roentgens per hour (R/hr) or milliroentgens per hour (mR/hr).

### CD V-700

This survey meter is known as the Geiger-Mueller counter or, more popularly, as the Geiger counter or GM meter. It detects beta radiation and measures gamma radiation in the low range up to 50mR/hr. If the radiation field is high, the instrument may become saturated and produce inaccurate readings.

The meter detects both beta and gamma radiation unless a special shield is placed over the probe. The shield stops beta radiation, so when it is in place only gamma radiation is detected. The only control on the CD V-700 is a selector switch that has an OFF position and three ranges labeled x100, x10 and x1. Remember, these meters measure gamma radiation but only detect beta radiation (they cannot measure beta radiation).

**CDV-700**

To use the CDV-700, follow these steps:

1. Check to see that fresh batteries are in place. If not, insert them.
2. Turn the range selector switch to the x10 range.
3. Allow 30 seconds for the instrument to warm up.
4. Open the probe shield and place the open area directly against the check source on the side of the instrument. The meter needle should deflect, indicating it is responding to radiation.
5. Determine the background radiation level by setting the instrument on the most sensitive scale (x1) and observing it for about 30 seconds. (Background radiation is usually less than 0.05 mR/hr or under 50 cpm when the selector switch is on the x1 range. The needle may jump randomly on this setting because of erratic background radiation).
6. Set the meter to the x100, x10, or x1 selection. On the x1 setting, the radiation exposure rate is as shown on the meter. On the x10 and x100 ranges, the meter readings must be multiplied by 10 and 100 respectively to obtain the correct reading. If the meter deflects full scale on the x1 or x10 ranges, select a higher range on the selector switch.

The CD V-700 will not give a correct reading if exposure rates are above 1 R/hr. Use a higher-range instrument when radiation exposure levels exceed 50 mR/h, the maximum that the CD V-700 can measure.

## CD V-715

This survey meter measures high-level gamma radiation up to 500 R/hr. It cannot be used to detect background radiation, alpha or beta particles, or low-level gamma radiation (less than 50 mR/hr).

**CD V-715**

To use the CD V-715, follow these steps:

1. Check to see that a fresh battery is in place. If not, insert one.
2. Turn the selector switch to the zero position.
3. Allow approximately two minutes warm-up time.
4. Adjust the zero control so that the meter reads zero. Without proper zero adjustment, the instrument may not read correctly.
5. Turn the selector switch to CIRCUIT CHECK (the needle should point to this area).
6. Recheck the zero setting on all four ranges.
7. Begin surveying with the instrument set on the x0.1 range.
8. Slowly move the probe over the site of suspected contamination, avoiding contact between the surface and the probe. Hold the probe about one inch from the site being monitored. Survey the entire body, head to toe, paying particular attention to wounds and body orifices.

The selector switch on the CD-715 has seven positions: CIRCUIT CHECK, OFF, zero, x100, x10, x1, and x0.1. On the x1 range, the radiation exposure rate is as shown on the meter. On the x0.1, x10, and x100 settings, multiply the meter readings by factors of 0.1, 10 and 100 respectively to obtain an accurate measurement.

Alpha surveys are usually performed to detect surface contamination that may lead to exposure by inhalation, ingestion, or absorption through open wounds. Because alpha counters are difficult to use properly and may be misinterpreted, alpha surveys should be performed by experienced personnel.

If you are trained in the use of a CD-700 or CD V-715 survey meter, keep in mind that these instruments measure only radiation levels, *not contamination levels*. However, you can assume that if radiation is present, you may be exposed or contaminated.

## Ludlum M3 Survey Meter

The Model 3 is a portable survey instrument with four linear ranges used in combination with dose rate or CPM meter dials.

Four linear range multiples of x0.1, x1, x10, and x100 are used in combination with the 0-2 mR/hr meter dial; 0-200 mR/hr can be read with a range multiplier.

To use the Ludlum M3 Survey Meter, follow these steps:

1. Open the battery lid and install two “D” size batteries. Note (+) (-) marks on the inside of the lid. Match the battery polarity to these marks.
2. Switch the range switch to BAT. The meter should deflect to the battery check portion of the meter scale. If the meter does not respond, recheck that the batteries have proper polarity.
3. Connect a detector to the M3.
4. Turn the instrument range switch to x100. Expose the detector to a check source. The speaker should click with the AUDIO ON-OFF switched to ON.
5. Move the range switch to the lower scales until a meter reading is indicated. The toggle switch labeled F-S should have fast response in “F” and slow response in “S”.
6. Depress the RES switch. The meter should zero.
7. Proceed to use the instrument.

To assure proper operation of the instrument between calibrations, an instrument operational check should be performed prior to use. A reference reading with a check source should be obtained at the time of initial calibration or as soon as possible afterwards, for confirming correct operation. Confirm the proper reading on each scale.

If the instrument fails to fall within + 20% of proper reading, it should be sent in to a calibration facility for recalibration.

# Dosimeters

Each individual entering a suspected radiation area should wear a **personal dosimeter**. Personal dosimeters measure cumulative exposure, that is, the total amount of radiation exposure during the period of measurement. Personal dosimeters should be worn on the outside of personal protective equipment. The three most common types are described below:

- **Pocket Dosimeter:** This is a direct readout instrument that resembles a fountain pen and is worn clipped to the outside of personal protective equipment. An advantage of pocket dosimeters is their ability to provide an immediate dose reading in the field. There are models to detect both high and low levels of exposure.

**Pocket Dosimeters**

- **Film Badge**: Film badges contain photographic films sensitive to X-ray, gamma, and beta radiation, giving an approximate measure of cumulative exposure. Badges must be processed to obtain their results.

**Film Badges**

- **Thermoluminescent Detector (TLD)**: TLDs contain crystals of salts that can record beta, gamma, and X-ray radiation. They have a very wide range of detection. Like film badges, TLDs must be specially processed for results. TLDs are processed by heating the crystal and releasing the trapped electrons. Over time, TLDs lose their accuracy because electrons will be released from their "trapped" location.

# TREATING PATIENTS

If victims are involved in a radiation incident, move them away from any potential area of contamination unless this increases the risk of injury. Remember to treat serious wounds first. Consequently, do not waste time measuring radiation levels. *Start first aid immediately*. You can do a quick initial radiation survey of the patient if you have the appropriate equipment and know how to use it. But remember that conventional life-saving first aid always has priority unless you suspect a high dose (400 to 600 rad). In these cases, victims need immediate treatment for radiation illness.

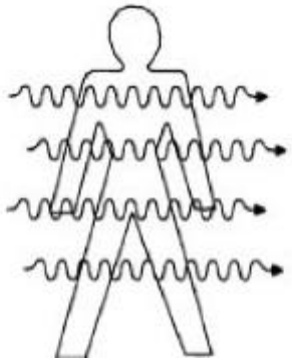
Identify contaminated parts of the victim's body using a disaster tag. If you take meter readings, note these readings on the tag. The tag will give hospital personnel important information about the patient's status.

There are a number of ways patients can be contaminated by or exposed to radiation. The patient may be:

- Exposed to an external source of radiation
- Contaminated externally
- Contaminated internally
- Have a contaminated wound

## Exposure to External Sources

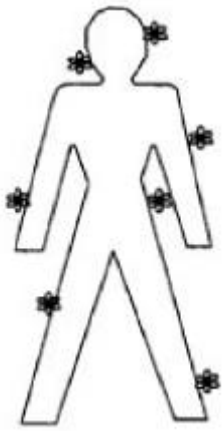
Patients that have been exposed to external sources of gamma, x-ray, or neutron radiation do not pose contamination problems. The degree of radiation injury depends on the amount of the dose. If the whole-body exposure exceeds 100 rem, symptomatic treatment at a specialized hospital may be needed.



**Patient exposed to radiation from external source**

# Externally Contaminated Patients

Contamination means that radioactive materials in the form of gases, liquids or solids are released into the environment and 1) come into contact with and 2) remain on a patient. Externally contaminated patients should be checked with a radiation survey meter because the radiation can be a hazard if it spreads. Even if external contamination is present, give lifesaving assistance immediately. Wear gloves, a gown, cap and mask and wrap the patient in a blanket or sheet for transport. Save all clothing, bedding and clothing in appropriate containers and mark them as RADIOACTIVE - DO NOT DISCARD.



**Externally contaminated patient**

# Internally Contaminated Patients

Patients who are internally contaminated have inhaled or ingested radioactive materials. Once that happens, the radioactive material is distributed through the body based on its chemical properties. For example, radium targets bone, iodine the thyroid gland. Depending on the radioactive material, treatment can be given to prevent further uptake, or to promote removal of the material from the body. Medications used for this purpose are specific to the radioactive material and are given by the receiving hospital. There is little a First Responder can do in these cases. It's important to remember that patients may also be externally contaminated.

**Internally contaminated patient**

# Contaminated Wounds

In patients with contaminated wounds, your primary objective is to treat the wound, then prevent the further spread and absorption of radiation. Clean the wound and cover it with a self-adhering surgical drape. Flood adjacent skin with saline. Save and identify all particulates as well as irrigating fluid and tissue.

Be sure to notify the receiving hospital if you are bringing in patients who have been contaminated with or exposed to radioactive materials. For contaminated patients, the hospital may want to set up a decontamination area. After you transfer the patient, you and the other responders must be surveyed for contamination. Discard contaminated clothing in plastic bags and shower if necessary. Do not leave the area until you are released by a health physicist. You will also need to survey your unit and all the equipment used to treat the patient.

# CONTROLLING AND REPORTING HAZARDS

## Controlling Releases

Low level materials generally do not present a significant threat. However, your safety, as well as the safety of the public and other responders is still a concern. The primary points to remember when dealing with a radiation incident are:

- Remember that rescue, life-saving, first aid and control of a fire and other hazards take priority over measuring radiation levels
- Notify the appropriate radiation authority
- Isolate spills or leaks for at least 80 to 160 feet in all directions
- If the spill is large, consider downwind evacuation of 330 feet
- If a fire is involved, consider evacuation of 1,000 feet in all directions
- Move containers away from fire if you can do so safely, but do not move damaged packages
- Cover liquid spills with sand, earth or a noncombustible material; dike large spills
- Cover powder spills with a plastic sheet to reduce spreading

## Reporting Releases

OSHA and NRC require extremely detailed and lengthy reports of all radiation incidents. A preliminary report may be issued months before a final document. Because the time between the incident and final report can be very long, it is critical that you keep good records of your initial response. Keep exact notes of:

- Date, time of day, and exact location
- Scene diagrams
- Atmospheric conditions
- Monitoring results
- Sequence of events
- Names of persons you contacted